Assessing the biocompatibility of silver nanoparticles with Schmidtea mediterranea, a stem cell model organism

Assessing the biocompatibility of silver nanoparticles with *Schmidtea mediterranea*, a stem cell model organism

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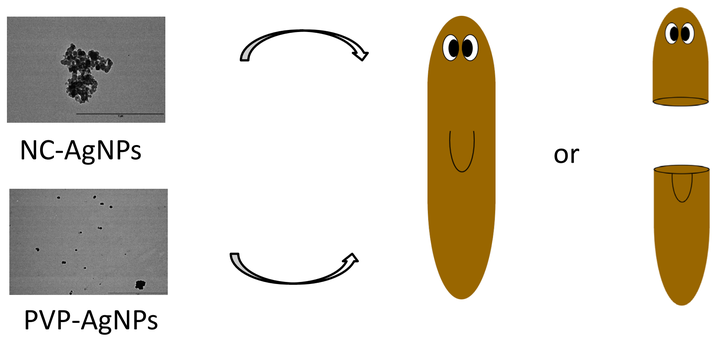
Introduction:

- Silver nanoparticles (AgNPs) are widely used for their antibacterial properties.
- AgNPs have a cyto- and genotoxic potential and can affect different tissues and cell types, including stem cells.
- In-depth knowledge on stem cell toxicology essential in understanding the heterogeneity of toxic responses.

Exposure to silver nanoparticles:

20 nm, non-coated and PVP-coated AgNPs, 10 – 35 mg/l exposed during homeostasis and regeneration.



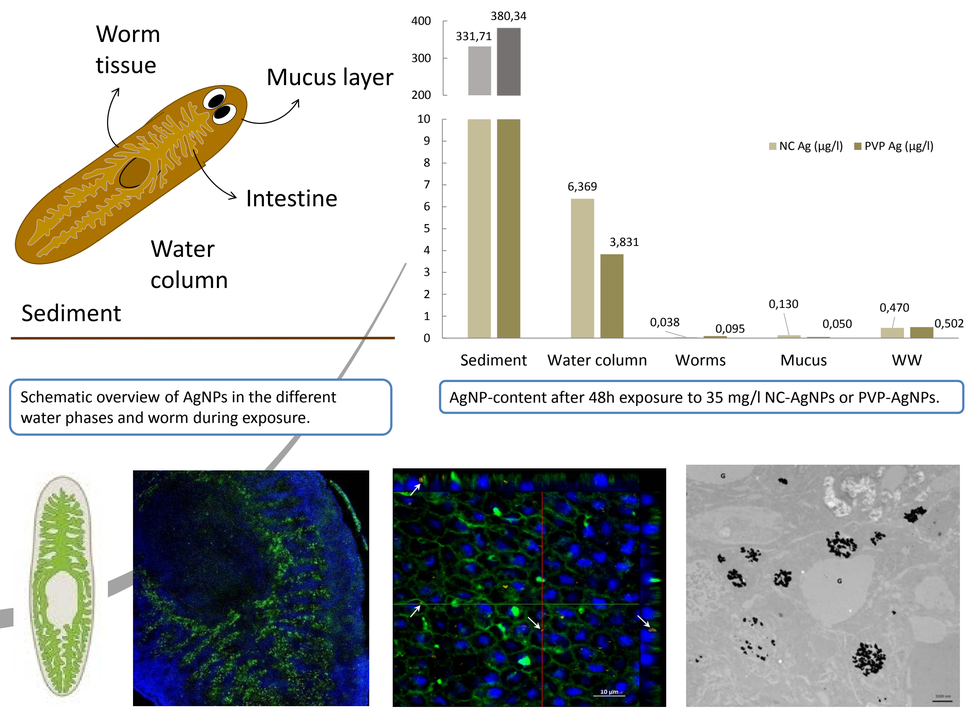
Research methods:

AgNP characterisation, uptake & distribution, sensitivity & effects on physiology

- Size , agglomeration, zeta-potential (sp-ICP-MS, TEM, DLS)
- Analytic (sp-ICP-MS) & microscopic (confocal & TEM)
- LC50, motility & behavior
- Size of regeneration bud (blastema)
- Development of brain & eyespots (immunohistochem.)
- ROS & stem cell proliferation (histone H3)

Effects on regeneration, neurodevelopment & cellular effects

Results: uptake and distribution



Schematic overview of AgNPs in the different water phases and worm during exposure.

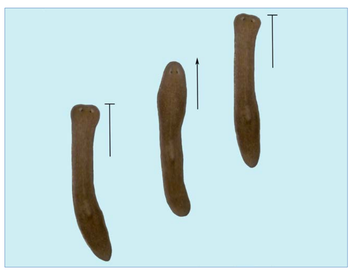
AgNP-content after 48h exposure to 35 mg/l NC-AgNPs or PVP-AgNPs.

Confocal image of PVP-AgNP (green) and nuclei (blue, Ruby), 10 day exposure to 35 mg/l.

Confocal image of PVP-AgNPs (orange), membranes (green, WGA) and nuclei (blue, Ruby). 10 day exposure to 35 mg/l.

TEM image of PVP-AgNPs in the intestinal cells surrounding the gut (G in the micrograph), 3 hours after injection.

Results: effects on behavior & motility (physiology)



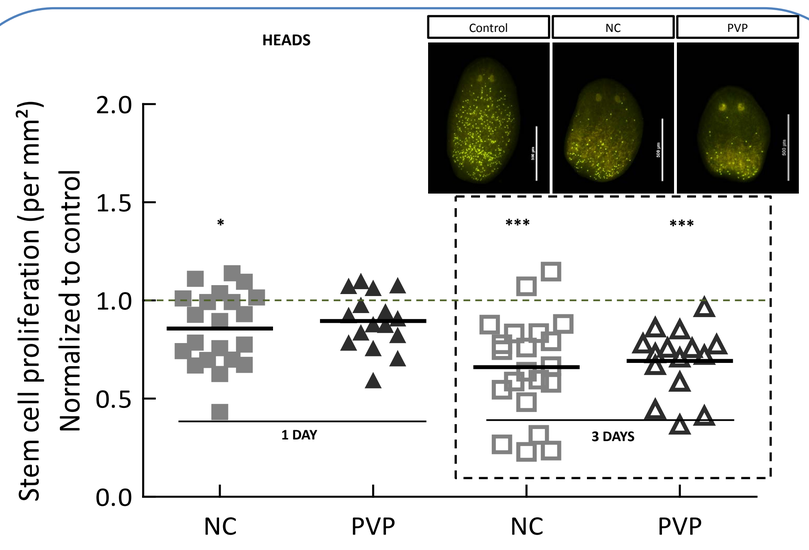
Dragging (r), Screw-like movement (l) instead of normal gliding movement.

Effect is concentration dependent and stronger for PVP-AgNPs than for NC-AgNPs.

Conclusions:

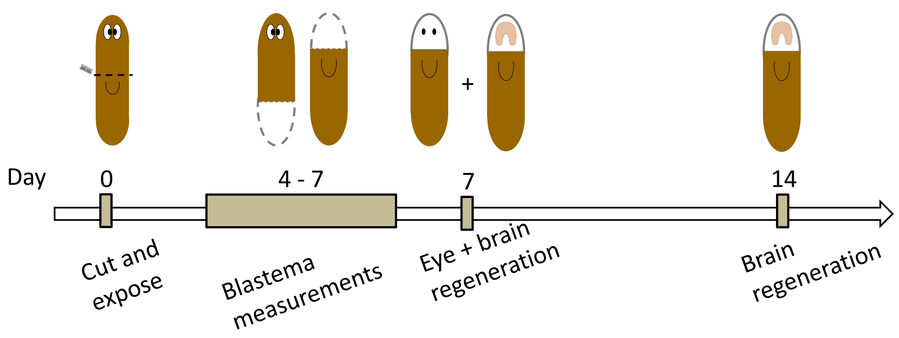
- Confirmed uptake by our planarian model.
- Variety of physiological effects, stronger for PVP-AgNPs.
- Higher sensitivity of regenerating animals
- General impairment of tissue & nervous system regeneration & development.
- Decreased stem cell proliferation.

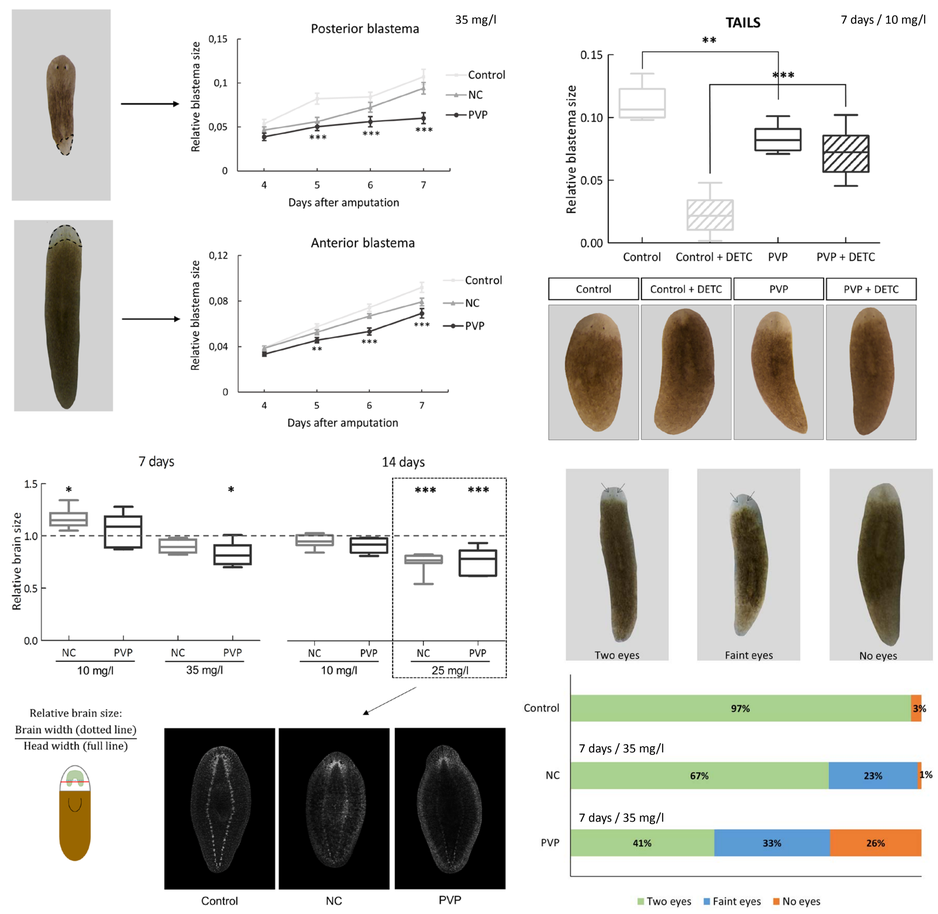
Results: effects on stem cell dynamics



Cell proliferation in regenerating heads after 1 or 3 days of exposure to 35mg/l NC- or PVP-AgNPs. Number of mitotic cells per mm² measured by Histone H3-mitotic staining. Measurements are expressed relative to control animals (proliferation per mm² = 1).

Results: effects on regeneration & development:





Effects on blastema size (top left), effects on blastema size under inhibition of SOD (top right). Effects on development of brain (bottom left) and on development of eye spots (bottom right).

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